A Comprehensive Field Book for Describing and Sampling Soils

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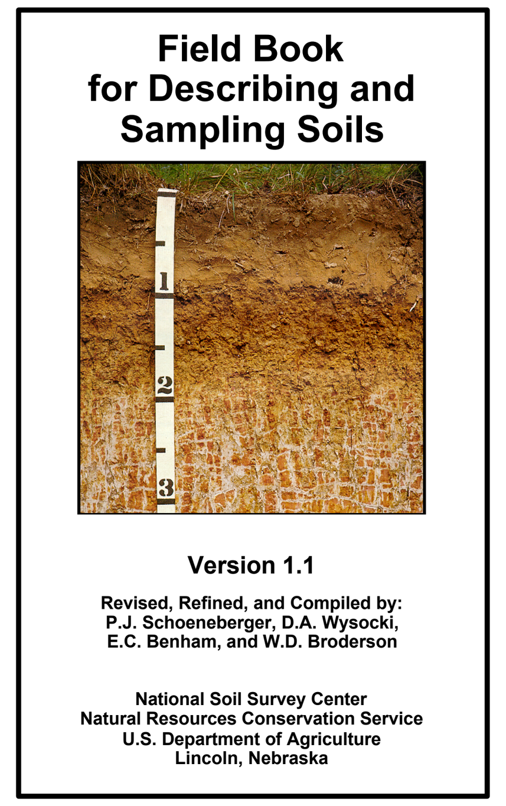
Introduction

Soil Science is a field science, at its core, inextricably tied to soils as they occur across the land. The first and most fundamental steps are the accurate observation, interpretation, and recording of soil information on-site.

Standard procedures and terms for describing soils have changed and increased in recent years. This is the first comprehensive presentation, in a field book format, of the current National Cooperative Soil Survey (NCSS) standards and conventions for describing soils as practiced in the United States.



Uses

Applications

- Standard reference for:
  - Describing soils (soil survey, site investigations); and
  - Deciphering abbreviated (short-hand, codes) or outdated soil descriptions.
- Training
- Education

Audience

- The entire Soil Science community including --
  - NCSS (NRCS and cooperating members);
  - Other federal, state, and local agencies;
  - Universities;
  - Private sector consultants; and
  - Related natural science members (archeology, engineering, geology, ecology, agronomy, hydrology).

Format

- Pocket-sized
- Waterproof
- Non-glare
- Loose-leaf (6-ring binder)
- Tabbed
- Sources: Many definitions and criteria are summated or abbreviated. Primary sources are identified and extensive references are provided.

Availability

National Cooperative Soil Survey cooperators:
National Soil Survey Center
Federal Building, Room 152, MS 33
100 Centennial Mall North
Lincoln, NE 68508-3866
Phone: (402) 437-5499 Fax: (402) 437-5336

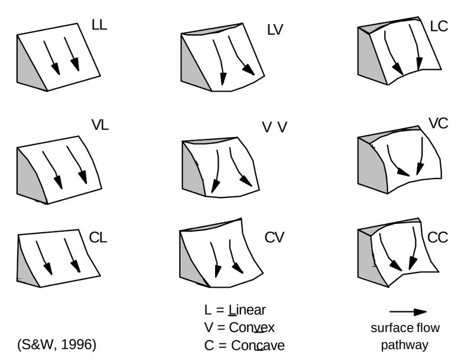
Web Site:
www.nssc.nrcs.usda.gov
- Select "Standards for Soil Survey"
- Select "Field Book for Describing and Sampling Soils"

Contrary to previous statements, copies of the "Field Book" **are not presently available for sale to the private sector** from the Government Printing Office. We are working to resolve this situation. When the document is available for sale, specific information will be posted on the above web site.

Content (section names with examples)

Site Description

Slope Shape - Slope shape is described in two directions: up-and-down slope (perpendicular to the contour), and across slope (along the horizontal contour); e.g., *Linear, Convex* or *LV*.



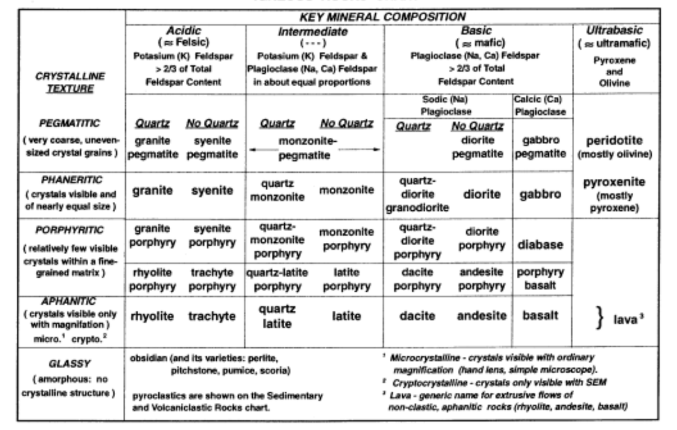
PARENT MATERIAL - KIND - e.g., *saprolite, loess, colluvium*.

Kind [1]	Code PDP	Code NASIS	Kind [1]	Code PDP	Code NASIS
EOLIAN DEPOSITS (non-volcanic)					
eolian deposit	E	EOD	loess, calcareous	--	CLO
eolian sands	S	EOS	loess, noncalcareous	--	NLO
loess	W	LOE	parna	--	PAR
GLACIAL DEPOSITS					
drift	D	GDR	till, ablation	--	ATI
glaciofluvial deposit	--	GFD	till, basal	--	BTI
glaciolacustrine deposit	--	GLD	till, flow	--	FTI
glaciomarine deposit	--	GMD	till, lodgement	--	LTI
outwash	G	OTW	till, melt-out	--	MTI
supraglacial debris-flow	--	SGF	till, supraglacial	--	UTI
till	T	TIL	till, supraglacial melt-out	--	PTI
IN-PLACE DEPOSITS (non-transported)					
grus [2]	--	GRU	saprolite [2]	--	SAP
residuum [2]	X	RES			
MASS MOVEMENT DEPOSITS [4]					
mass movement deposit	--	MMD	mudflow deposit	--	MFD
block glide deposit	--	BGD	rockfall avalanche dep.	--	RAD
colluvium	V	COL	rockfall deposit	--	RFD
creep deposit	--	CRP	rotational landslide dep.	--	RLD
debris avalanche deposit	--	DAD	scree	--	SCR
debris flow deposit	--	DFD	soil fall deposit	--	SFD
debris slide deposit	--	DSD	talus	--	TAL
earthflow deposit	--	EFD	topple deposit	--	TOD
lateral spread deposit	--	LSD			

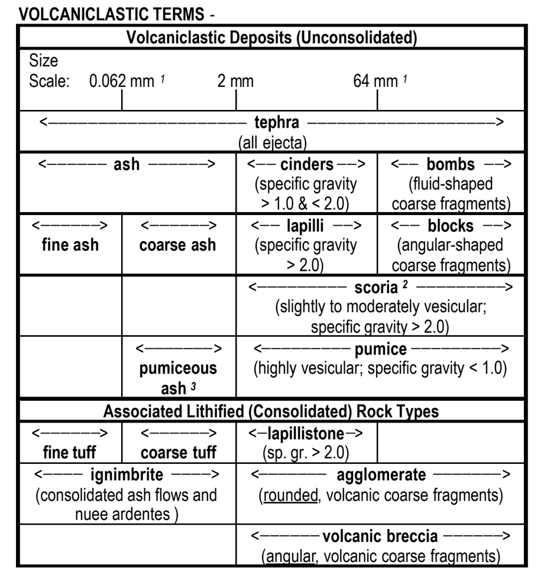
etc.

Geology

IGNEOUS ROCKS CHART



VOLCANICLASTIC TERMS -



1 These size breaks are taken from geologic literature (Fisher, 1989) and based on the modified Wentworth scale. The 0.062 mm break is very close to the USDA's 0.05 mm break between *coarse silt* and *very fine sand* (Soil Survey Staff, 1993). The 64 mm break is close to the USDA's 76 mm break between *coarse gravel* and *cobbles*. (See "Relationships Among Particle Size Classes and Different Systems" in the "Profile / Pedon Description Section", under "Soil Texture".)
2 A lower size limit of 2 mm is required in Soil Taxonomy, but is not required in geologic usage (Fisher, 1989).
3 The descriptor for pumice particles < 2 mm, as used in Soil Science. Geologic usage does not recognize any size restrictions for pumice.

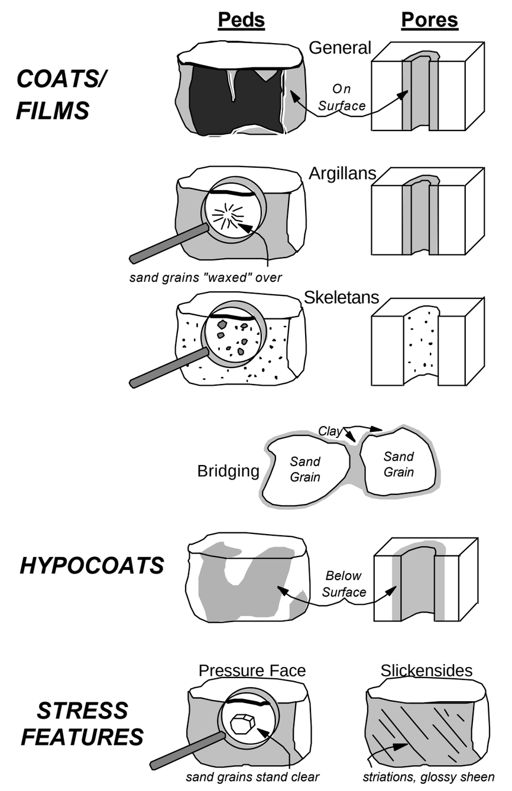
Profile and Pedon Description

PED & VOID SURFACE FEATURES - KIND (non-redoximorphic) -

Kind	Code PDP	Code NASIS	Field Criteria
COATS, FILMS (exterior, adhered to surface)			
Carbonate Coats	K	CAF	off-white, effervescent with HCl
Silica (silans, opal)	--	SIF	off-white, noneffervescent with HCl
Clay Films (Argillans)	T	CLF	waxy, exterior coats
Clay Bridging	D	BRF	"wax" between grains
Ferriargillans Described as **RMF - Kind**		see RMFs	Fe^{+3} stained clay film
Gibbsite Coats (sesquan)	G	GBF	$AlOH_3$, off-white, noneffervescent with HCl
Manganese (mangans) Described as **RMF - Kind**		see RMFs	black, thin films effervescent with H_2O_2
Organic Stains	--	OSF	dark organic films
Organoargillans	O	OAF	dark, organic stained clay films
Sand Coats	Z	SNF	separate grains visible with 10X
Silt Coats [1]	R	SLF	separate grains not visible at 10X
Skeletans [2] (sand or silt)	S	SKF	clean sand or silt grains as coats
Skeletans on argillans	A	SAF	clean sand or silt over clay coats
HYPOCOATS [3] (A stain infused beneath a surface.)			
STRESS FEATURES (exterior face)			
Pressure faces (i.e. stress cutans)	P	PRF	look like clay films; sand grains uncoated
Slickensides	K	SS	slip face; grooves, striations, glossy or shiny

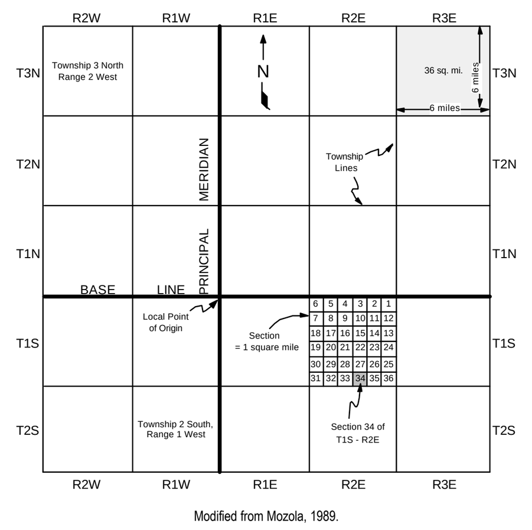
1 Individual silt grains are not discernible with a 10X lens. Silt coats occur as a fine, off-white, noneffervescent, "grainy" coat on surfaces.
2 Skeletans are (pigment) stripped grains > 2 µm and < 2 mm (Brewer, 1976). Preferably describe either silt coats (grains not discernible with 10X lens), or sand coats (grains discernible with 10X lens).
3 Hypocoats, as used here, are field-scale features commonly expressed only as Redoximorphic Features. Micromorphological hypocoats include non-redox features (Bullock, et al., 1985).

PED & VOID SURFACE FEATURES -



Location

PUBLIC LAND SURVEY -



Geomorphic Description

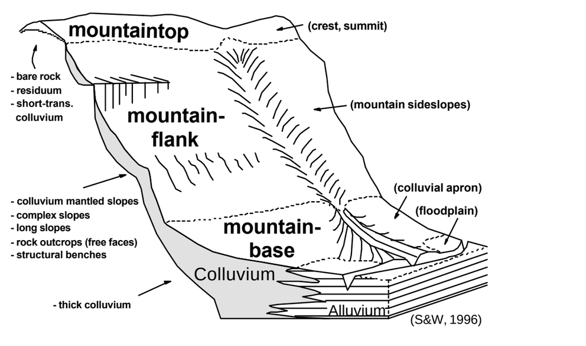
(Geomorphic Description System, ver. 2.06)

PART I: PHYSIOGRAPHIC LOCATION
A) Physiographic Division
B) Physiographic Province
C) Physiographic Section
D) State Physiographic Area
E) Local Physiographic / Geographic Name

PART II: GEOMORPHIC DESCRIPTION
A) Landscape
B) Landform
C) Microfeature
D) Anthropogenic Features

PART III: SURFACE MORPHOMETRY
A) Elevation
B) Slope Aspect
C) Slope Gradient
D) Slope Complexity
E) Slope Shape
F) Hillslope - Profile Position
G) Geomorphic Component
1. Hills
2. Terraces
3. Mountains
4. Flat Plains (Proposed)
H) Microrelief

GEOMORPHIC COMPONENTS - MOUNTAINS



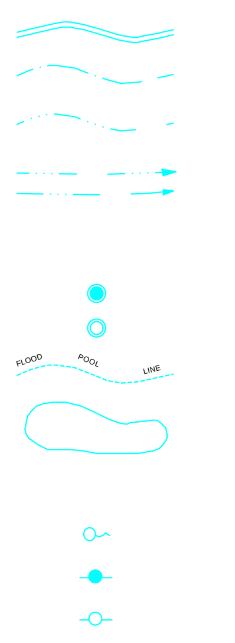
Miscellaneous

COMMON SOIL MAP SYMBOLS (TRADITIONAL) -

HYDROGRAPHIC FEATURES:
STREAMS:
Perennial, *double line*
Perennial, *single line*
Intermittent
Drainage end

SMALL LAKES, PONDS AND RESERVOIRS:
Perennial water
Miscellaneous water
Flood pool line
Lake or pond *(perennial)*

MISCELLANEOUS WATER FEATURES:
Spring
Well, artesian
Well, irrigation

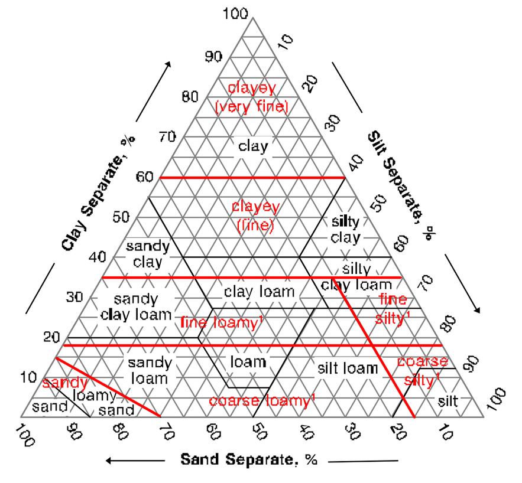


COMMON CONVERSION TABLE -

Known	Symbol	Multiplier	Product	Symbol
acres	ac	0.405	hectares	ha
acre-feet	acre-ft	1233.5019	cubic meters	m³
acre-furrow-slice ≈ 2,000,000 lbs	afs (assumes b.d. = 1.3 g/cm³)	= 6 in. thick layer that's 1 acre square		
Angstrom units	A	1x 10⁻⁸	centimeters	cm
Angstrom units	A	1x 10⁻⁴	microns	m
Angstrom units	A	1.0133 x 10⁶	dynes/cm²	
Atmospheres	atm	760	mm of mercury (Hg)	
BTU (mean)	BTU	777.98	foot-pounds	
centimeters	cm	0.0328	feet	ft or '
centimeters	cm	0.03937	inches	in or "
centimeters/second	cm/s	1.9685	feet/minute	ft/min.
centimeters/second	cm/s	0.0224	miles/hour	mph
chain (US)		66	feet	ft
chain (US)		4	rods	
centimeters	cm³	0.06102	cubic inches	in³
cubic centimeters	cm³	2.6417 x 10⁻⁴	gallons (U.S.)	gal
cubic centimeters	cm³	0.999972	milliliters	ml
cubic centimeters	cm³	0.0338	ounces (US)	oz
cubic feet	ft³	0.02832	cubic meters	m³

etc.

Soil Taxonomy



[1] Very fine sand (0.05 - 0.1) is treated as silt for family groupings; coarse fragments are considered the equivalent of coarse sand in the boundary between the silty and loamy classes.

HORIZON NOMENCLATURE CONVERSION CHART -

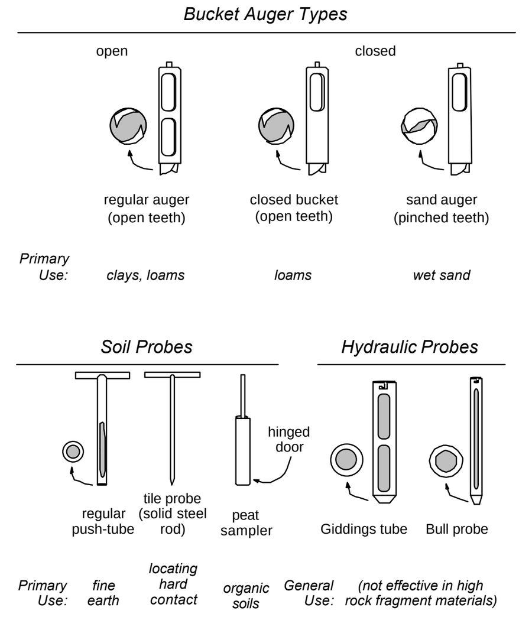
Horizon Suffixes (also called "Horizon Subscripts", and "Subordinate Distinctions")

1951 [1]	1962 [2]	1981 [3]	1997 [4]
---	---	a	a
b	b	b	b
ca	ca	(see *k*)	(see *k*)
cn	cn	c	c
cs	cs	(see *y*)	(see *y*)
---	---	e	e
f	f	f	f
---	---	---	ff
g	g	g	g
h	h	h	h
ir	ir	(see *s*)	(see *s*)
---	---	i	i
---	---	---	j
---	---	---	jj
(see *ca*)	(see *ca*)	k	k
m	m	m	m
sa	sa	n	n
---	---	o	o
p	p	p	p
(see *si*)	(see *si*)	q	q
---	r	r	r
(see *ir*)	(see *ir*)	s	s
si	si	(see *q*)	(see *q*)
---	---	---	ss (1991)
t	t	t	t
---	---	v	v
---	---	w	w
x	x	x	x
(see *cs*)	(see *cs*)	y	y
	sa	z	z

1 Soil Survey Staff, 1951.
2 Soil Survey Staff, 1962
3 Guthrie and Witty, 1982.
4 NRCS Soil Classification Staff, 1997; personal communication.

Field Sampling

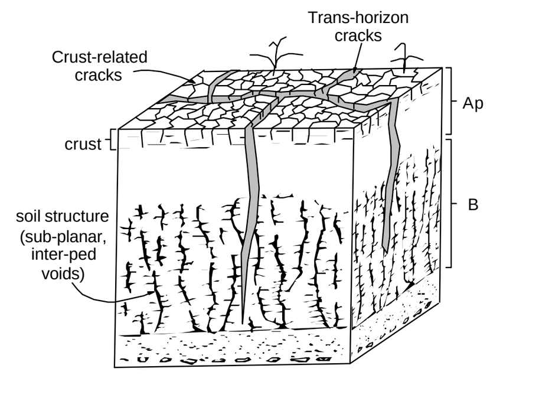
EXAMPLES OF COMMON FIELD SAMPLING EQUIPMENT -



New Items

Clarifying Discussions

- Cracks
  - clarification of definitions, types, measurement



- Horizon and Soil Depth
  - ground surface (not mineral surface)
  - water (if it supports emergent plants)
- Redoximorphic Features (RMFs)
  - refinement of definitions, kinds

REDOXIMORPHIC FEATURES - KIND -

Kind	Code PDP	Code NASIS	Kind	Code PDP	Code NASIS
REDUCED MATRIX (chroma ≤2 primarily from Fe^{+2})					
Reduced Matrix	---	RMX			
REDOX DEPLETIONS (loss of pigment or material)					
Clay Depletions	A3	CLD	Iron Depletions (includes depletion halo)	F5	FED
Chroma > 2	---	HCD	Chroma > 2	---	HFD
REDOX CONCENTRATIONS (accumulated pigment, material)					
Masses [1] *(noncemented)*					
Iron (Fe^{+3}) [3,4,5]	F2	F3M	Iron-Manganese [3,4,5]	M2	FMM
Iron (Fe^{+2}) [2]	---	F2M	Manganese [4,5]	M8	MNM
Nodules [1] (cemented; no layers, crystals not visible at 10X)					
Ironstone	F4	FSN	Iron-Manganese [4]	M5	FMN
Plinthite	F1	PLN			
Concretions [1] *(cemented; distinct layers, crystals not visible)*					
Iron-Manganese [4]				M3	FMC
Surface Coats / Films or Hypocoats					
Manganese *(mangans: black, very thin, exterior films)*				M [6]	MNF
Ferriargillans *(Fe^{+3} stained clay film)*				I [6]	FEF

1 See discussion under **Concentrations** for definitions.
2 A concentration of reduced iron Fe^{+2}; e.g., *FeS*.

- Concentrations
  - recognized Finely Disseminated Materials and Biological Concentrations
- Penetration Resistance
  - new table for converting pocket penetrometer readings into penetration resistance classes
- Chemical Response
  - more chemical agents and uses

EFFERVESCENCE - CHEMICAL AGENT -

Effervescence Agent	Code PDP	Code NASIS	Criteria
HCl (unspecified) [1]	H	H1	Hydrochloric Acid: Concentration Unknown
HCl (1N) [1,2]	I	H2	Hydrochloric Acid: Concentration = 1 Normal
HCl (3N) [1,3]	J	H3	Hydrochloric Acid: Concentration = 3 Normal
HCl (6N) [1,4]	---	H4	Hydrochloric Acid: Concentration = 6 Normal
H_2O_2 (unspecified) [5,6]	P	P1	Hydrogen Peroxide: Concentration Unknown
H_2O_2 [5,6]	O	P2	Hydrogen Peroxide: Concentration 3-4%

REDUCED CONDITIONS -

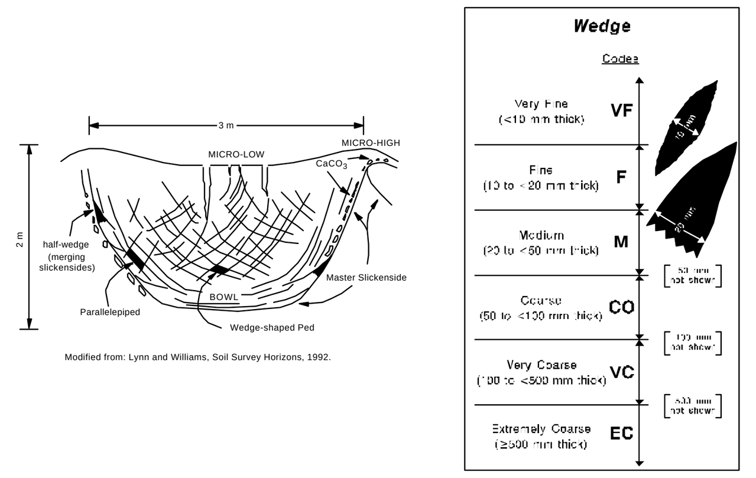
Chemical Agent	Code	Criteria
α,α'-dipyridyl [1]	P (= *positive*) N (= *negative*)	α,α'-dipyridyl conc.= 0.2%, (Childs, 1981)

1 Positive reaction indicates presence of Fe^{+2} (i.e., reduced conditions).

- Saturated Hydraulic Conductivity (Ksat) vs. Permeability
  - clarification of terms and differences

New Descriptors

- Wedge Structure
  - for materials with relatively high shrink-swell characteristics, e.g., Vertisols, vertic intergrades, etc.



- Odor
  - to recognize some highly reducing anaerobic conditions, presence of certain contaminants

Odor - Kind	Code	Criteria
Sulphurous	S	Presence of H_2S (hydrogen sulfide); "rotten eggs"; commonly associated with strongly reduced soil containing sulfur compounds.
Petrochemical	P	Presence of gaseous or liquid gasoline, oil, creosote, etc.

USDA NRCS
Natural Resources Conservation Service

SOIL SURVEY 1899 1999 CENTENNIAL